Plant Operations Notebook, N-93-05-22

This notebook covers the period May 1893-August 1895. It was used primarily by Joseph W. Harris for notes, calculations, and drawings from bricking experiments. The book reflects Edison's own involvement through marginalia in Edison's hand and notes by Harris regarding Edison's individual experiments. Among the more unusual experiments is a test to determine whether the bricks "could be used [as] a substitute for building and paving bricks." The front cover is labeled "Data on Bricking Iron Ore Concentrate" and "Bricking Data & Muck." The spine is labeled "Data of Later Bricking Work." The pages are unnumbered. Approximately 120 pages have been used. A one-page letter from Harris to Edison has been inserted into the book.

XE-172 N-93-05-22

Joseph W. Harris

Laboratory Note Book.

Record of time required to bake bricks of one to the correct point, and of time required to cool off, after removed from ovens.

Four bricks to a number, each set of bricks on a bed of about 1/4" of ore, to prevent burning.

material, 30 resin
15 Lima Petroleum
45 lbs mixture to 2240 ore
= 1 - 50

#1

Temp. when put in 230°F — Time in 4.35
Time out 4.40
Impeller removed 310°F — Total time 0.5
Time when cold 5.05

#2

Temp 230°F — Time in 4.35
" 330°F — Time out 4.45
Total time 0.10
Time when cold 5.10

3

Temp 230°F Time in 4.35
" 330°F Time out 4.50
Total time 0.15
Time when cold 5.15

4

Temp 230°F Time in 4.35
" 340°F Time out 4.55
Total time 0.20
Time when cold 5.20

5

Temp. 230°F Time in 4.35
" 350°F. Time out 5.00
Total Time 0.25
Time when cold 5.30

6

Temp. 230°F Time in 4.35
370°F Time out 5.05
Total time 0.30
Time when cold 5.35

7

Temp 230°F Time in 4.35
" 372°F Time out 5.10
Total time 0.35
Time when cold 5.40

8

Temp 230°F Time in 4.35
" 376°F Time out 5.15
Total time. 0.40
Time when cold 5.45

9

Temp. 230°F Time in 4.35
" 375°F Time out 5.20
Total Time 0.45
Time when cold 5.55

10

Temp 230°F Time in 4.35
" 376°F Time out 5.25
Total Time 0.50
Time when cold 6.00

11

Temp 230°F Time in 4.35
" 370°F Time out 5.30
Total Time 0.55
Time when cold 6.05

12

Temp. 230°F Time in 4.35
380°F Time out 5.35
Total Time 0.60
Time when cold 6.10

Earlier record of taking tests, with notes by Mr. Edison.

#1
Temp 342°F
Time 5
Taken away 5.40
very soft

#2
Temp 370°F
Time 10
very soft
MAE

#3
Temp 370°F
Time 15
Soft, & Crumbles
Fair
would do E

#4
Temp 376°F
Time 10
Stood my weight
Could not break with fingers &
not so soft, but
crumbles

#5
Temp 382
Time 25
better. would not stand weight
not so soft
still crumbles.

#6
Temp 380
Time 30
Stood my weight
End on off
getting hard -
not so much
crumbling -
Very hard
Unnecessarily hard

#7
Temp 380
Time 35
further on
they got little
softer

#8
Temp 380°F
Time 40

#9
Temp 380°F
Time 45

Temp #10 378
Time 50

Temp #11
Temp — 382
Time 55
43 [illegible] [illegible] Cold

Temp #12
Temp. 390°7
Time 60

Temp #13
Temp. 386
Time 65
Taken out at 6.40
23 minutes
just only
[illegible]
warm

Assay of Lima petroleum for Sulphur.

100 cc. (82.7 grams) treated with HNO_3 until all is oxidized, residue dissolved in caustic Potash free from sulphur acidified with Hcl, ppd. with $BaCl_2$, filtered, filter fused with Na_2CO_3, redissolved in Hcl & added $BaCl_2$, filtered, filter dried, and detached from paper. Paper ignited in weighed crucible reduced to ash, $BaSO_4$ added, heated to dull red heat, weighed.

Weight of $BaSO_4$ minus ash, 0.435 grams

contains 0.0725 % Sulphur.

Estimation of residue in Lima Petroleum.

22.720 grams pet. placed in weighed dish, heated on sand bath for a week, until all had been carbonized residue weighed 0.830 grams =

3.653 % residue.

Examination of Rosin for Acids.

Sample of a very clear rosin, probably "X" or "W" taken as standard, and assumed to be 100% pure, as it gave no insoluble residue. = 20.0 cc of alkaline solution.

Sample of regular "B" rosin used, and neutralized with same soda solution, = 19.3 cc, or 96.5%

Sample of dross rosin, neutralized with same ~~soda~~ solution, = 17.7 cc. = 88.5%

Dross rosin gave 0.234 grams of insoluble matter, such as sand & chips, in 2 grams of rosin = 12.7%

or with clear rosin as standard, the dross rosin = 101.2%, the clear rosin probably = 99%.

With B rosin as standard, dross rosin = 91.7% pure.

Experiments on mixing the
ore with muck in the machine.

#1

30 lbs Rosin
15 lbs Burning oil, the rosin
dissolved in the oil.

Ore at a temperature of 225 °F.
mixed very well. O.K.

#2

30 lbs Rosin dissolved in
15 " Lima Oil

Ore at 200 °F.

O.K.

#3

30 lbs Rosin dissolved in
12 " Lima Oil

Ore cold

did not mix at all.
no good.

#4

30 lbs rosin dissolved in
12 " Lima Oil

Ore at 120° F.

did not mix very well.

5

30 lbs Rosin dissolved in
15 lbs Lima Oil

Che cold

no good.

6

30 lbs Rosin dissolved in
12 " Lima Oil

Che at 150 °F,

mixed very well, O. K.

Examination of a sample of crude rosin strained through burlap.

2 grams used = 15.5 cc = 77.5 %
or, compared with "B" rosin = 80.31 %

Examination of a sample of Chips from Rosin works, for rosin

100 grams, dissolved in CH_4O, filtered, treated with Na_2O, CH_4O evaporated off, acidified, filtered, washed + melted, melted mass weighed 52 grams

52 % Rosin

May 22nd 1893

Experiments with bricks of ore, made with
30 lbs Rain, 15 lbs Lima Petroleum, (L)
30 " " 15 " Perma " (P)
30 " " 15 " Bayone " (B)

6 bricks of each kind made, and heated to 350° F. one of each taken out every 10 minutes, to find out which oil distills off first, and basis the brick bond.

45 lbs mixture, to 2250 lbs ore = 1 – 50

Bricks set on tin plates, and arranged as follows, each kind represented by the letters.

10	20	30	40	50	60 minutes.
L	P	B	L	P	B
B	L	P	B	L	P
P	B	L	P	B	L
1	2	3	4	5	6

1

10 minutes, Temp in 354° F
3.30 – 3.40 P.M. out 310° F
Cool at 4.00 P.M.

1 (duplicate)

15 minutes. — Temp in 388° F
3.10 – 3.20 P.M. out 336° F
Cool at 4.00 P.M.

On putting all bricks in oven, temp. fell to 300° F.

L Best
P next
B third

2

20 minutes Temp in 354° F
3.30 – 3.50 P.M. out 312° F
Cool at 4.08 P.M.

2 (duplicate)

20 minutes. Temp in 388° F
3.10 – 3.30 P.M. out 354° F
Cool at
4.10 P.M.
L Best
P next
B third

L is apparently hard enough for Practice

3

30 minutes — Temp. in 358° 7, out 330° 7

3.30 - 4.00 P.M.

Cool at 4.22 P.M.

#3 (Duplicate)

30 minutes — Temp. in 388° 7, out 368° 7

3.10 - 3.40 P.M.

Cool at 4.20 P.M.

L one side seen and well does not crush with Mus.E - weight, as effect under bell

P Half island Mus.E - weight

Both lack weight.

B quite strong not so good as L or P

L in air at 20 or 40 minutes is crushed.

Bazine will not answer —

4

40 minutes — Temp. in 354° 7, out 350° 7

3.30 - 4.10 P.M.

Cool at 4.35 P.M.

#4 (Duplicate)

40 Minutes — Temp. in 388° 7, out 370° 7

3.10 - 3.50 P.M.

Cool at 4.25 P.M.

L

P

B much softer than L or P

Piece

L in Put in Turpentine + Kerosene in 5 minutes, that in Turpentine had begun to fall to pieces, while that in Kerosene did not show any signs of crumbling.

5

50 minutes — Temp in 354°7

3.30 – 4.20 P.M. out 358°7

Cool at 4.45 P.M.

5 (Duplicate)

50 minutes — Temp in 388°7

3.10 – 4.00 P.M. out 370°7

Cool at 4.37 P.M.

L

P.

B softer than L or P

P. put in H_2O out 6.45 P.M. May 23 – at 6.30 Am May 24, was still whole and looked as if it was impervious to water.

6

60 minutes — Temp in 354°7

3.30 – 4.30 P.M. out 360°7

Cool at 5.00 P.M.

6 Duplicate

60 minutes — Temp in 388°7

3.10 – 4.10 P.M. out 370°7

Cool at 4.45 P.M.

L.

P.

B softer than L or P.

L – Put in H_2O at 6.45 P.M. May 23 – at 6.30 Am May 24, was still whole and looked as if it was impervious to water

8,00 | 22,49 | 2.8 per cent
7,6 4,00

28 | 3,50
7,22 0

Experiments on reheating bricks to ascertain if they soften again. May 24th 1893

at 4.20 P.M.

2 L (20 minutes) softens at 300°F.
4 P (40 minutes) " " 420°F

at 320°F, #5 B (50 minutes) was put in, was very soft at 470°F.

at 490°F, all very soft.

Experiments on Black petroleum residue mixed with Lima Oil.

25 B.P.R. (Black petroleum residue) (Sludge Acid)
5 L. Oil } 30 lbs per 2240 lbs ore

#1 15 minutes soft
#2 30 " hard
#3 45 " "
#4 60 " "

Mixed cold, not very sticky, made good brix.

20 B.P.R. (Black petroleum residue) (Sludge Acid)
10 L. Oil } 30 lbs per 2240 lbs ore

2 brix
1 20 minutes hard
2 40 " "

mixed cold – not as sticky as above – did not make good brix.

3 of the 5-25 mixture heated to a Red heat in the muffle for over one hour and 20 minutes after which, and during which time, it remained perfectly hard + solid.

May 24th 1843

Made 3 bricks of 45-2240 with Resin + Lime Calc + heated to 500°F for

500°F # 1	20 minutes,	soft,
500°F # 2	40 "	hard.
500°F # 3	60 "	hard.

1 put back again for 1 hour longer = 80 minutes

2 was allowed to cool, + placed in muffle, to heat it up to a red heat. It was continually rubbed while being heated, and did not soften.

Experiment on brieking, with sluge
May 26th 1893
acid tar and Lima Petroleum,
in the proportion of 30 lbs sluge acid
and 5 lbs Lima = 35 lbs per ton
Started 10.40 AM.

3 brix made –
heated to 400°F + taken out at
furnace at 410°F.

#1 – 20 minutes taken out at 11.00 AM. at 390°F
#2 – 40 " " " 11.20 " 395°F
#3 – 00 " " " 11.40 " °F

#1 very soft when removed
#2 " " " "
#3 hard, but could be harder

June 3rd 1893

Experiment on brick made with 30
lbs sluge acid tar, + 10 lbs Lima
Petroleum, to 2240 lbs ore –

Brick made in small mold,
heated to 500°F, for 60 minutes.
After cooling, was very hard,
it weighed 169.250 grams –
It was then placed in water for 47
hours, during which time, it did
not soften nor crumble. After
removing, and drying between
blotting paper, it weighed

173.400 grams
169.250 "
4.150 ∴ water

169.250) 4.150000000 (
2.44

took up 2.44 % of water in
47 hours.

June 5th 1893

Experiments to determine the most economical proportion between time and temperature at which the briq of iron ore must be baked, using the 30 & 10 mixture of sluge acid and lima petroleum

The experiments are divided into Series each separate series denoted by a letter, each letter represents a temperature at which the furnace is supposed to be kept.

Series	A	— 450 °F
"	B	500 °F
"	C	550 °F
"	D	600 °F
"	E	650 °F
"	F	700 °F

Series A - 450 °F -

Brick removed from furnace every 15 minutes.

No.	minutes -	temp.	quality -
# 1	15	410	soft
2	30	422	"
3	45	438	hard
4	60	440	"

1 not hard enough, even after cooling for several hours also all the volatile substances had not been driven off.

Series B - 500° F -

Brick removed every 10 minutes.

no	minutes	Temp.	quality
1	10	420°F	soft
2	20	456°F	"
3	30	465°F	"
4	40	492°F	hard
5	50	478°F	"
6	60	476°F	"

Nos. 5 and 6 are all right
#5 stopped giving off volatile gases.

each took 40-45 minutes to cool.

#6 is the brick used in the water experiment.

numbers 5 + 6 are all right.

Series C. 550°F

Brick removed every 10 minutes

no	minutes	Temp.	quality
1	10	440	soft
2	20	486	"
3	30	500	"
4	40	510	hard
5	50	495	"
6	60	495	"

#5 does not give off volatile gases.

Temp. fell rapidly towards close of expt.

Series D - 600°7 -

brick removed every 5 minutes.

No	minute	Temp.	Quality
1	5		soft
2	10		"
3	15		"
4	20		"
5	25	no guess given off	hard
6	30		"
7	35		"
8	40		"
9	45		"
10	50		Oxidized
11	55		"
12	60		"

Could not measure temp. by thermometer, expt. performed in muffle furnace.

Series E - 650°7

Brick removed every 5 minutes.

No	minute	Temp	Quality
1	5		soft
2	10		"
3	15		"
4	20		"
5	25	no guess given off	hard
6	30		"
7	35		"
8	40		"
9	45		"
10	50		Oxidized
11	55		"
12	60		"

Could not measure temp.

Expt made in muffle furnace.

Series F. 700 °F

brick removed every 3 minutes.

No	minutes	temp	Quality
1	3		
2	6		soft
3	9		very
4	12		soft
5	15		~~[illegible]~~ hard
6	18		harder.
7	21		
8	24	no gases given off	
9	27	some gas given off	
10	30	gases given off	soft
11	33	no gases	hard
12	36	no gases	hard
13	39	some gases	little soft
14	42	no gases	hard
15	45	oxidized	
16	48	"	
17	51	"	
18	54	"	
19	57		
20	60		

The giving off of gases during the middle of run is due to the brick being near the muffle door, & therefore not being heated as much.

Notes on the above bricks, by Mr. Edison

Series A

(not satisfactory Hopkins) #4 would do (but all volatile substances have not been driven off Hopkins)

Series B –

#5 + #6 will answer

Series C –

20 minutes 6 feet up, broke little very little fuse, not strong, but would answer if nothing bet

Series C - (continued)

30 minute — 8 feet, broke in two or three pieces, seems hard by hand very little fines, well do

40 minute — Seems very hard, 8 feet, 3 pieces, no fines

50 minute — 8 feet - 2 pieces no fines

60 Minute - 8 feet - did not break. very hard -

Series D -

~~40~~ 5 minute — all soft

10 min. — fair - 3 feet - broke, 3 pieces, + some fines.

15 min. — Hard 8 feet - 2 pieces no fines -

20 min — 8 feet - did not break - hard

25 min. — broke - 8 feet, fines, probably oxidized in muffle -

30 min — all went to powder.

35 min. — 8 feet 2 pieces no fines -

40 min — 3 pieces 8 feet, no fines -

45 - min — Powered, I find on looking at it, is oxidized.

50 min — 8 feet did not break.

55 min — Oxidized, went to powder -

Series E –

5 min. soft

10 min – 2 pieces, 8 feet very little powder.

15 min 3 pieces little soft in middle, would do

20 min 3 pieces, 8 feet no fume –

25 min 5 pieces, no fumes, notice it is oxidized

remainder seem to be oxydized.

A number of experiments were made with different mesh tails from magnetic or concentrates, from Edison, N.J., during Sept - 1893.

Tails were mixed in varying proportions with (a mixture of 30 lbs) Rosin and 15 lbs. Penna petroleum (which gave better results in preliminary experiments than either Lima Petroleum, or Sludge Acid) all the way from 30 lbs of mixture per ton to 150 lbs mixture per ton.

The tails used were 14 mesh crude ore, 50 mesh tails, 50 mesh Concentrates, bin dust, & blower dust from this bin dust.

The best results are as follows. The bricks after baking in a box filled with charcoal, for about 2 hours, at 600°F, were thrown up in the air by Mr. Edison, and fell on the asphalt pavement of the chemical room.

150 lbs rosin mixture, 1 ton 50 mesh tails

(notes) did not break at 5 feet, not at 10 feet. broke at 25 feet, probably good at 15 feet

125 lbs rosin mixture, 1 ton of dust from bins.

did not break at 4 feet, nor at 10 feet, nor
(notes) at 30 feet, chipped at second trial at 30 feet, very hard.

100 lbs of rosin mixture, 1 ton of dust blown from bin dust -

chipped at 10 feet, broke at 25 feet, duplicate broke at 20 feet, is hard.

125 lbs rosin mixture, 1 ton of dust blown from bin dust.

did not break at 4 feet, chipped badly at 10 feet, duplicate chipped at 20 feet, broke at 30 feet, very dense

150 lbs rosin mixture, 1 ton of dust from bin dust,

chipped at 5 feet, did not break further at 20 feet, duplicate broke at 20 feet, hard and dense.

The remainder of experiments were, practically, no good. They broke all to pieces at distances between 4 and 12 feet, some even broke from a fall of 3 feet.

Sept - 15th 1913

Some 50 mesh tails were mixed with the regular 30 lbs Rosin and 15 lbs Pennsylvania Petroleum mixture (Lima, did not answer as well) in proportions from 40 lbs to 120 lbs of mixture to 1 ton of tails.

The 120 lbs per ton was found to be necessary. The bricks intended to be baked at different high temperatures in a furnace, to see if they could be used as a substitute for building and facing bricks.

4 of the 120 lbs per ton bricks were placed each in a ~~carbon~~ graphite crucible and surrounded with charcoal, and placed in large furnace in Room 3 - ~~4th~~ and heated to an orange heat, when the 1st was removed (sufficient time being allowed to get hot all through in each case) the second

was removed at a yellow heat, the third at a low white heat, and the 4th at a bright white heat.

After cooling 36 hours, they were opened, the 1st was like or much sand, the second was just beginning to harden but was still very crumbly, the third was hard, tough, but very porous inside. The fourth had all contracted out of shape, was full of large holes caused by the feldspar melting and ~~running~~ running together, leaving spaces, but was very hard.

The third is the best. By all means, is hard, had not lost its shape very much, but was porous.

The experiment was repeated without the use of charcoal in the crucible, then bricks cracked and crumbled very easily between the fingers.

Oct 10th 1893

About 100 large flat bricks of the following shape,

were made of regular Baltimore Sludge Acid and Lima-Petroleum, (30 + 10) when it was found that after baking they absorbed water. Before baking, the mixture was not so sticky as formerly. This is due to the slow oxidation of the sludge. If this sludge be mixed in the proportion of 30 lbs to 5 lbs of Lima Petroleum, and 40 lbs of the mixture used, it makes a good strong water-repellant brick, when heated for 1 hour at 400°F. After an immersion of 17¼ hours a brick made as above absorbed 0.88% of water. If heated to 400°F for 30 minutes, absorbs 8.9% H_2O in 22½ hours.

Oct 11th 1893

Experiments were made with Burns' sample of sludge acid H_{10}, from the Kings County works of the Standard Oil Co, for bricking, without the use of Lime. It is done by first mixing the sludge with say 1/3 of the ore, and then mixing this in with the rest of the ore.

When bricked, before baking, it absorbs water, and also after baking.

If only heated to 400°F, for 1 hour, do not take up much water, if heated to 500°F take up still less water, but if heated to 600°F, takes up considerable water.

Bricks made in screw press.

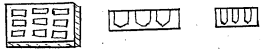
Heated to 400°F for 45 minutes, cooled, and placed in water for 45 hours, took up 4.05% of water

Heated to 500°F for 45 minutes cooled, placed in H_2O for 47 hours. took up 2.05% H_2O

Oct 16th 1893

Brick made with Baltimore sludge and Lime, 30 lbs sludge, 5 lbs lime, 40 lbs mixture per ton of ore.

made in a mould shaped as follows



This brick made in screw press with a gentle pressure, heated to 395°F for 1 hour + 10 minutes. When removed, gave off no vapors, but was not hard, being still soft to the pressure of the tongs.

A brick made in other mould (see Oct 18) and made under similar conditions, except that a much greater pressure was applied, was fully 3 times as hard.

Experiments made on
Burns's samples of Sludge acid.

1

Brick made with 45 lbs of a mixture of 40 lbs #10 sludge, 5 lbs Lima. mixes well, does not 'flow', when bricked in hand mould, cracks in half as water bricks do.

2

Brick made with 50 lbs of 45 lbs sludge, 5 lbs lima. mixes well, 'flows' a little, is not sticky cracks in hand mould and takes up water before baking.

Determination of loss of weight occasioned by washing #10 sludge until it is free from H_2SO_4.
Cold water only, used.

Weight of	
evaporating dish,	34.852 grams
sludge and dish,	38.074 "
Sludge	3.222 "
Glass rod	3.202 "
Dish, Sludge, and rod	41.276 "
Dish, sludge, and rod after washing	40.244 "
Loss in weight,	1.032 "

Weight of sludge before washing	3.222 "
Loss in weight	1.032 "
Weight of sludge after washing	2.190

Loss 32 %

In another case, lost nearly 50 %.

Oct 16th 1893

Some #10 sludge acid was washed until it no longer gave any acid reaction and was then heated in the steam bath to drive off all the water, or it does not make sticky bricks. It is not a very sticky substance, after drying.

6

Brick made with 45 lbs of 40 lbs washed #10 sludge and 5 lbs lime mixed well, flows, made in screw press, was water repellant before heating.

Heated to 395° F for 1 hour + 10 minutes.

after cooling, was immersed in water for 45 hours, absorbed 2.6%

7

Brick made with 40 lbs of a mixture of 50 lbs washed #10 sludge, 5 lbs lime. Mixed in sections, mixes well, flows fairly well, bricked in hand mould.

absorbed water before heating

baked at 400° F for 1 hour, hard when removed.

Immersed in water for 23 1/4 hours absorbed 1.25 %.

8

Brick made with 50 lbs #10 washed sludge alone, mixed in sections. not good, very dry, would probably require 125 lbs per ton to be any good.

#9

Brick made with 40 lbs of a mix lime of 35 lbs washed and dried #12 sludge, 5 lbs lime.
mixes well, fairly sticky, bricks well, is quite strong, but absorbs water before baking.
Heated to 400° F for 1 hour.

Immersed in water for 23½ hours absorbed 2.02 %

#10

40 lbs of 30 lbs #11 sludge and 10 lbs lime.

no good, too stiff, even when mixed in sections.

#11

45 lbs of 30 lbs #11 sludge, 15 lbs lime.

Sludge seems to have oxidized, as it is not now completely soluble in Lime.

Is not sticky when mixed with the ore and when made in hand mould by hand, cracks as water bricks.

made in screw press appears to be all right.

Made in screw press.

heated to 410° F for 1 hour, gave off some vapors when removed.

Immersed in water for 12 hours absorbed 1.73 %

12

42 lbs of 30 lbs #11 sludge,
12 lbs lime.
mixed well. flow,
bricked by hand & plate.
bricked in screw press, is all
right. is water repellant before
baking. Made in screw press
Heated to 400 for 1 hour, did
not give off vapor on removing
from the furnace.

Immersed in water for 12 hours
absorbed 1.64 %

13

40 lbs of 35 lbs #1 sludge,
5 lbs lime
mixed well, flow well, is sticky
is water repellant before baking.
Brick made by hand.
heated to 4 10°F for 1 hour
still gave off vapor when removed
from the furnace.

Immersed in water for 18 1/4
hours, absorbed 1.3 %

#14

50 lbs of 30 lbs #11 sludge, 12 lbs lime

mixes well, flows, does not crack when made by hammer in small mould.

brick made by hand

heated to 410°F for 1 hour.

When removed, still gave off gases.

immersed in water for 18¼ hours,

absorbed 2.26%

#15

45 lbs of 30 lbs #11 sludge and 12 lbs Lime.

mixes fair, flows fair, is not very sticky, has a tendency to crack when made by the hammer in small mould.

Did not water repellant before heating, although the surface becomes wet.

Bricked by hand.

heated to 410°F for 1 hour.

immersed in water for 18¼ hours,

absorbed 2.35%.

16

75 lbs # 27 sludge residue
well ground up, to 1 ton ore.

no good

17

90 lbs of 75 lbs # 27 sludge, 5 lbs lime
1 ton ore.

no good.

18

60 lbs ~~#~~ of 50 lbs # 27 sludge and
10 lbs crude molasses.

no good

19

50 lbs # 19 sludge
1 ton ore -

no good.

20

55 lbs of 50 lbs # 19 sludge
5 lbs lime -
1 ton ore

no good.

24

100 lbs # 19 sludge
1 ton ore

mixes well can be bricked, but
brick is weak, and absorbs water
before heating

25

105 lbs of 100 lbs #19 sludge
5 lbs Lima –

1 ton re –

mixes well bricks well, is weak and absorbs water.

A number of experiments were made with washed # 27 sludge, small portions being ground and heated with equal weights of over 50 different inorganic salts and compounds, the mixtures afterwards tested for solubility in Penna Petroleum, and water.

Bricks were also made with some of the more promising mixtures, but not one of them gave any satisfactory results. The sludge did not seem to combine with any of them, and separated in the petroleum each time.

Bricks made with them would not hold their shape on removing from the mould. They all fell to pieces.

Oct 26th 1893

Experiments made w/ leaching ore with H_2SO_4

Mr. Edison poured some strong H_2SO_4 w/ some ore, and left it to stand over night. In the morning it had caked to a very hard mass, and was broken with difficulty by hand.

#1

1 ton ore
100 lbs of a 10% sol of H_2SO_4 by weight
mixed in mortar, and heated on sand bath –

no good.

#2

1 ton ore,
50 lbs 10% sol H_2SO_4
mixed in mortar, heated w/ sand bath – no good

#3

1 ton ore
50 lbs of a 20% sol H_2SO_4
no good

#4

1 ton ore
25 lbs of a 20% sol H_2SO_4
no good

#5

1 ton ore
50 lbs of a 40% sol H_2SO_4

#6

1 ton ore
100 lbs of a 50% sol crystalized $FeSO_4$
no good

#7

1 ton ore
25 lbs H_2SO_4 sp.g. 1.66

#8

1 ton ore
50 lbs of a 50% sol crystalized $FeSO_4$
no good

#9

1 ton ore
25 lbs of a 50% sol $FeSO_4$
no good

#10

1 ton ore
150-200 lbs conc sol $Al_2(SO_4)_3$
no good

#11

1 ton ore -
100 lbs of a 25% sol $Al_2(SO_4)_3$
no good

#12

1 ton ore
200 lbs of a 20% sol H_2SO_4
acid poured on ore -

#13

1 ton ore
300 lbs of a 10% sol H_2SO_4
acid poured on.

~~Oct~~ Nov 6th 1893

Mr Edison mixed some conc H_2SO_4 with some ore (did not weigh) and placed it in a long wide glass tube, open at both ends, but a piece of asbestos cloth tied over the bottom to act as a filter. Some refined kerosene to which H_2SO_4 had been added, & then the purified kerosene filtered off, was then poured on the ore, so that it had about an equal volume as the ore. The tube was in a vertical position.

In two hours, the ore expanded in volume, cracked the tube, the kerosene ran through the cracks in the glass, but the ore had caked into a solid mass, which could hardly be broken with a hammer. Mr. Edison thinks a Calcium-Hypo-sulphite was formed.

Nov. 6th 1893

Some 300 bricks were made of a mixture of 30 lbs Baltimore sludge, 5 lbs of Lima Petroleum, 40 lbs per ton of ore used.

Bricks made in large square mould in screw press, two young men operated the press.

One was heated to 400°F for 1 hour when removed vapors were still given off, and was soft.

Some were heated to 500°F for 1 hour were not quite hard when removed and still gave off vapors of petroleum.

Remainder were heated to 520°F until no more vapors came off. It required 3 hours to do this.

When cold, one brick was thrown in the air as follows

6 feet did not break
12 " " " "
25 " " " "
75 " " " " but it chipped a little at the corners.

In each case the bricks fell on a wood floor.

In heating the bricks, vapors do not seem to be given off as heavy fumes until after a temp of 425°F had been reached, so at 400°F only after a much longer time.

A portion of one placed in water for 23 hours, absorbed 4.4%

Nov 8th 1893

Some bricks were made with 4 oz of 30 lbs Baltimore sludge and 5 lbs Lima to 1 ton ore.

Made in screw press.

Water note the surface before heating.

Heated to 500° F for 1 hour, still gave off fumes when removed.

One thrown as high as main Laboratory, fell on wood floor did not break, thrown up again, and did not break.

Portion of one placed in water for 24 hours, absorbed 3.46 %

These bricks shipped to
Pilling & Crane
Bullitt Bldg.
Philada.

Nov. 9th 1893

Some bricks were heated to different temperatures for different lengths of time, and then tested for water.

#1

Brick heated to 500° F for 1 hour, did not give off gases on removing from the furnace, was hard.
Placed in water for 22 hours, absorbed 6.34 %.

#2

Brick heated to 450° F for 1 hour, still gave off gases on removing from furnace, was hard.
Placed in water for 22 hours, absorbed 2.44 %

#3

Brick heated to 400° F for 1 hour still gave off gases when removed from the furnace. was not very hard.
Placed in water for 22 hours, absorbed 3.12 %

#4

Brick heated to 400° F for 1½ hours still gave off gases on removing from the furnace. was hard.
Placed in water for 22 hours, absorbed 2.1 %

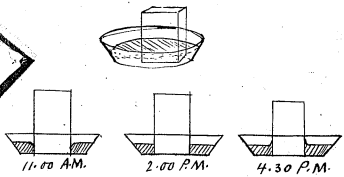
#5

Brick heated to 400° F for 2 hours did not give off any gases on removing from the furnace. was hard.
Placed in water for 22 hours, absorbed 2.84 %

all these bricks were thrown up to a heighth of about 50 feet and fell on wood, they all broke, #3 broke in small pieces, the remainder in large pieces.

Nov. 11th 1893

An unbaked brick placed in water as shown in sketch, to see if it absorbed much, and what the rate was.



Brick placed in water at 11.00 Am.
There was considerable repulsion betwen the brick and the water
at 2.00 P.M. The water was level at the edge of the brick
at 4.30 P.M. There was considerable attraction betwen the water and the brick.
At the end of three days, the brick had absorbed a very large quantity of water, it was wet all over.

March 7th 1894 -

Experiments were made with a view to reducing power required in mixing, by adding petroleum to the ore, then mixing a portion of the ore, say 1/3, with the juices, then add the balance of the ore.

2240 lbs ore
6 lbs Lima oil = 2 cts
22½ " 100 Rosin, 50 lima = 10 cts.

Mixes easily, but will not brick.

Tried naphtha, gasoline + Kerosene, they were not successful, naphtha evaporated to rapidly, gasoline the same, Kerosene reduced mixing a little, but did not make good bricks, it also evaporated soon.
Also tried Rosin Oil, it is to difficult to mix.

March 8th 1894

Experiments made with Rosin Oil & Rosin in Place of Lima Oil + Rosin.

Rosin Oil,
Sp. G. 0.99, cost 6 cts per gal.
= 0.75 pts per lb, = 1.33 lbs per 1 ct.

#1
10 grams Rosin,
1 " Rosin Oil } Solid when cold

#2 10 grams Rosin
2 " Rosin Oil } solid when cold

#3
10 grams Rosin
3 " Rosin Oil } solid when cold,

#4 10 grams Rosin
4 " Rosin Oil } very stiff when cold,

#5
10 grams Rosin
5 " Rosin Oil. } very stiff when cold, cost 29% more than 10 Rosin 50 lima.

#6
10 grams Rosin
6 " Rosin Oil } So stiff when cold!

March 9th 1894

Scotch Blast furnace pitch costs
about $8.00 per ton, 2240 lbs.

It is insoluble in
Lima Petroleum, Penna Petroleum,
refined Kerosene, benzine, naphtha, gasline.

It is partly soluble in
Rosin Oil, Turpentine, Wood tar Oil.

(The part which is insoluble in these, is probably the lampblack, of which the pitch contains about 30 %.)

Experiment made with
10 lbs Pitch
5 " Rosin Oil.
12 ozs wash, = 26 lbs per ton,
to difficult to mix, not very good after it is mixed well.

10 lbs Pitch,
10 " Rosin Oil,
12 ozs wash, = 22.34 lbs per ton,
hard to mix, after mixing is to dry, can not brick it in hand.

Experiments with Coal Tar Pitch -

#1
Creosote Oil dissolves it.

#2
1 Part Rosin Oil, 1 Part Lima dissolve it while hot, but the pitch separates on cooling.

#3
Blue Oil dissolves it hot, separates on cooling, pitch seems to be rotten after separating, it has been acted upon while hot, by the acid in the oil.

#4
10 Parts Rosin Oil 1 Part lima dissolve it, but it is very sticky after cooling.

#5
1 Part of (100 Rosin, 50 lima) and 2 Parts lima dissolve pitch while hot, pitch separates on cooling.

#6
Acid oil from petroleum works does not dissolve it.

#7
Separated Oil from petroleum works does not dissolve it

#8

Is partly soluble in Red oil, but does not give a sticky mixture.

#9

Wood tar Oil dissolves it, and is a sticky mixture.

#10

Separated acid Oil treated with Na_2O in solution, + Pitch added + heated.

The Na_2O separates sludge from the acid oil, + this melts with the pitch, the same result is obtained when dry Soda Hydrate is heated with the acid oil, the Na_2O combines with an acid which is soluble in H_2O + gives a brown ppt with $BaCl_2$ is a sulphonic acid.

#11

Small quantity of creosote heated with pitch, is to stiff when cold, if diluted with more creosote is not sticky.

#12

Blue Oil, Soda, Pitch, pitch separates on cooling, and is rotten as in #3.

#13

1 Part wood tar Oil, 2 parts pitch, Too stiff.

Experiments with the Coke residue, from Sludge Acid.

Is soluble in an excess of hot water, and gives a brown ppt with $BaCl_2$

If this water solution, which gives an acid reaction to litmus, be mixed with HCl, Zn + Fe, + heated, in left some time in the cold, a sticky sludge is obtained, although it is not so good as fresh sludge.

If dry coke stuff be ground with Na_2CO_3 in excess, + then treated with HCl to dissolve excess of Na_2CO_3, then washed with water, a sticky sludge is obtained by treating the last residue with chloroform, Benzol, toluol, Turpentine, Carbon Disulphide,

This ~~resid~~ sludge is soluble in strong Carbolic acid none of the ordinary solvents seem to affect it.

If dry coke sludge be boiled in lime Petroleum for about 15 minutes a sludge having a high melting point, but brittle when cold, is produced. The lime probably takes up the free acid in the coke stuff, and makes fresh sludge which melts with the coke stuff.

March 19th 1894

A + rosin was poured in a dry linen bag, it filtered through the press.

H rosin was poured in a wet linen bag, it evaporated the water + then filtered through

H rosin was poured in a linen bag that had been soaked in a saturated solution of Na_2CO_3, it evaporated the water + left a crust of Na_2CO_3 which closed the pores of the linen + the rosin did not filter through.

Rosin can therefore be shipped in burlap bags by first soaking the bags in a saturated solution of a soda, say Na_2CO_3, + then pouring the hot rosin in. Bags can be recovered + returned for more rosin.

A number of experiments were made from time to time, in small mixer, with quantities of ore varying between 150 lbs to 500 lbs, with varying quantities of Rosin 100, Lime 50, juice. It was found that bricks can be successfully made with 12½ cts worth of juice, 11½ cts worth of juice, & 10 cts worth of juice, but not lower than 10 cts.

The ore will to require 8 mixings in the machine, as follows –

1st 1/3 ore, all of the juice.

2nd 1/3 ore added,

3rd 1/3 ore added,

and then total ore passed through 5 times more.

This is equivalent to 4 times through the big mixer.

Bricks made with 12½ cts juice were not tested for water absorption.

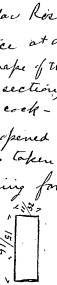
Tests made later show that 100 Rosin 62 Lime bricks absorb about 6.00% of water in 15 hours

March 26th, 1894

Experiments were made to determine the flow of Regular Rosin 100 Lima 50, juice through an orifice at different temperatures. The shape of the orifice was rectangular in section, and was the opening of a brass cock.

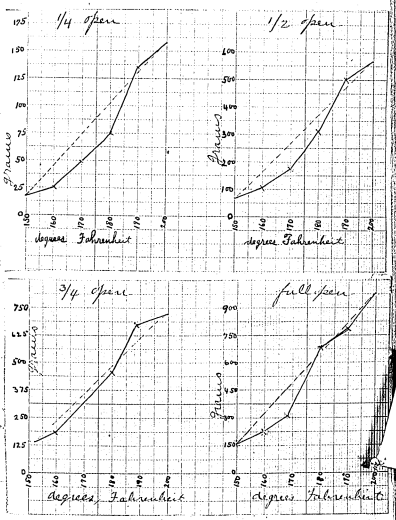
The cock was opened in 1/4 area periods, that is, a reading taken for 1/4, 1/2, 3/4, 1, each reading being for 10 seconds.

Area of opening.



Weight of juice in grams passed through the opening in 10 seconds at different openings & temperatures.

Temp	1/4	Temp	1/2	Temp	3/4	Temp	Full
150°F	16½	150°F	71	152°F	147	150°F	162
160	26	160°	117	160°	187	160°	230
170	50	170°	176			170°	315
180	74	180°	311	180°	462	180°	686
190	135½	190°	500	189	675	190°	989
200	158	200°	568	200	726	200°	978



April 3rd 1894

Experiments were made in small mixer with 2.75 lbs of ore each, with juice of varying proportions, from 100 Rosin & 50 Petroleum, to 100 Rosin 75 Petroleum.

The idea was to reduce the number of balls in the finished mixed stuff, by having a mush thin enough to spread easily, and thick enough to have a maximum of stickiness.

The best results were obtained with a juice consisting of 100 Rosin, 57½ Lime, to 100 Rosin 62½ Lime; between these limits, good results can be obtained in practice.

In mixing, the following order was observed. The mixer was ½ the length of full size mixer, so that it was run through 2 times the number of runs, making 8 runs, instead of 4.

First Run.

1/3 lbs, all juice mixed up outside of mixer, and poured in slowly.

2nd run
1/3 ore extra, and both run in together,

3rd run,
remaining 1/3 ore, run in along with the other two blends.

Remaining runs ~~on~~ concentrated of total ore.

The balls gradually diminished in number, until at the 6th run, practically none remain. It is quite pasty after the 8th run, and will break but after baking breaks about abt 6% of water during an immersion of 15 hours.

Juice made of Rain 100, Luna 12.

The small mixer mentioned ~~had~~ has 25 spreaders, each with a working surface of 5" wide x 8" long it rotates at 19 revs. per minute.

The blades have an angle of 2½" in 4" = an angle of 32½°

The torque of this mixer with 225 lbs ore in it, spread along the length is,

	starting torque	Running torque
with 10 lb springs in spreaders	55 lbs	50 lbs.
empty	9 lbs	7½ lbs
with 10 lb springs with 225 lbs ore in mixer	55½ lbs	54½ lbs.
with 20 lb springs ~~empty~~ - with 175 lbs ore in machine -	47½ lbs	45 lbs.

Pulley has a radius of 12", Gears are 5 - 1

End of spreaders is 8" from centre of shaft

Experiments were made with Rosin 100, Head Oil 62, in small mixer.

It mixes all right, no balls on 4th run, non subsequent runs, but it does not get very sticky. It is not as good as Rosin & Lime for bricking.

It absorbs 0.43% water in 15 hours.
Sp.g. Head Oil 1.02

Experiments were made with Rosin & Wood tar Oil. It was found that the best results are obtained by 100 Rosin, ~~100~~ 200 Wood tar Oil

Brick made by hand, in screw press, also mixed by hand.

It absorbs 4.27% water in 14 hours.

Experiments were made with Rosin & Wood Tar. It was necessary to use 100 Rosin, 250 Wood tar, 12 cts. per ton ore.

Mixed in small mixer balls all removed at 6th run.

The mixture is to wet after mixing, & cannot be bricked, cracks like water bricks.

Experiment made with 12 cts worth of 100 ~~Rosin~~ Scotch Pitch, 200 Wood tar, the pitch & tar were so heated & mixed at a low temperature, to not lose any volatile substances from the tar.

Mixed in small mixer. No balls at 6th run, after mixed, it cracks when bricked in screw press, it evidently contains too much water.

A mixture of 100 Scotch Pitch, 150 Wood tar mixed by hand, to stiff, bricked & baked, absorbs 4.3% of water in 15 hours.

Experiment with Scotch Pitch & Wood tar Oil.

100 Scotch pitch } 12½ cts worth per ton
250 Wood tar Oil. } re.

Mixed by hand – heated in a corn pan, after baking at 530°F for 1 hour, did not break at a fall of 6 feet on asphalt, did break at a fall of 10 feet on asphalt.

Absorbed 2.13% water in 14 hours.

May 1st 1894

Wood Tar contains so much water, that it cannot be used for bricking purposes.

Heated some with $ZnCl_2$, the $ZnCl_2$ seemed to be absorbed by the tar, it all disappeared & after cooling, no separation of watery substance occurred.

Heated some with $CaCl_2$, the $CaCl_2$ worked the same as the $ZnCl_2$.

Heated some with powdered burnt lime. The massive saponified by the lime, and if enough lime is used, the whole mass is combined, if a less quantity is used, it can be separated while hot with a sieve but the filtrate is worthless for bricking purposes.

Sulphuric acid acts on it, producing a watery, sticky substance, it produces a product like sludge acid, but it still absorbs water.

Sp. G. of Wood Tar is 1.14,

Some wood tar evaporated to 2/3 its weight, to reduce water.
It was then mixed with 10% of Wood Oil using 12½ cts. per tar, brick made in mortar.
It is hard to mix, will ball up in mixer, did not crack like water brick when bricked, baked at 540° F for 1 hour.
It did not break at a 6 foot fall on wood floor, did break at a 6 foot fall on asphalt floor.
Placed in water for 14 3/4 hrs, having absorbed 5.88%

Experiment in making Lime + Resin price with steam.

Steam at 65 lbs pressure gave a temperature of 285°F in coil. Resin placed in pan + coil in resin, the resin melted and became very thin inside the coil, but owing to the radiation it did not get so hot at the edges of the pan.
Resin melts at 275°F.
Steam at or above 65 lbs pressure, with suitable apparatus, will do the work.

May 3rd

Experiments with screw feed for pumping juice into niagara.

Juice consisting of 100 Ream 62 Lumacras ~~not~~ used, It was necessary to run screw at 380 revs. per min.

The screw had a pitch of 3½" length 50".

juice was pumped about 46' diameter of screw 3" with a working fit in a rough iron pipe.

Temp	Speed	Wt. per min.	Temp.	Speed	Wt. per min.
240°F	380	1lb 13 ozs	159°	378	34 lbs
250°F		1lb 8 ozs	155°	378	38¾ lbs
238°F		1lb 12 ozs	152°	379	39¾
230°F		2lbs 5 ozs	148°	382	42
220°F		3lbs 8 ozs	145°	379	44
216°F		4lbs 2 ozs	142°	380	46
210°F		5lbs 8 ozs	139°	378	45
207°F	380	7¼ lbs	136°	381	46
198°		10 lbs	133°	381	46
1750		11⅞ lbs	130°	375	44
170°		13¾	127°	380	4 lbs 11 ozs
186°		15 lbs	90°	380	40 lbs
182°	380	18½ lbs	127	306	36
180°		19½		205	22½
175°	368	19		153	15½
171°	375	23 lbs 3 ozs		121	9½
166°	375	28½		90	3 lbs 12 ozs
163°	380	32	90°	75	2 lbs

Experiments with screw feed using screw with 1" pitch, in place of screw with 3½" pitch –

Juice used same as before Ream 100, Lumac 62

Temp.	Speed	Wt. per min.
178°	352	6 lbs 3 ozs
170°	355	6 " 3 "
168°	350	6 " 5 "
166°	351	6 " 8 "
165°	352	6 " 8 "
160°	350	6 " 10 "
158°	351	7 " 3 "
154°	352	7 " 5 "
150°	354	7 " 8 "
148°	360	7 " 14 "
142°	355	7 " 13 "
139°	347	7 " 12 "
136°	352	8 " 2 "
134°	355	7 " 10
132°	356	7 " 10
130°	361	7 " 8 "
127°	361	8 " 13 "
125°	345	8 " 2 "

As the temperature fell below 125°F the agitation of the screw disintegrated the mass of juice. It forms a foam like suspende. It can be used between temp of 150°F to 130°F.

May 10th 1894

The following experiments were made in breaking, with Asphalt Oil + Beech Wood Creosote.

Asphalt oil will dissolve Rosin, Wood Tar Pitch, Scotch Pitch (except the lamp black).

Beech wood creosote will dissolve Rosin, Wood Tar Pitch, Scotch Pitch, Concentrated Wood tar, (Boiled down to 2/3 its weight).

Bricks were mixed by hand in mortar and made in screw press end of lever 3 feet from center, with one man on lever baked at 500 27 for 1 hour.

H 1

Rosin 100 Asphalt Oil 62, mixes easy, is not sticky. 12½ cts with wood.
broke on a 3 foot fall on asphalt floor,
Immersed in water 16 hours absorbed 1.5%

H 2

100 Wood Tar Pitch, 75 asphalt Oil, 12½ cts. hard to mix, not sticky. broke on a 3 foot fall on asphalt floor, immersed in H_2O 16 hours, absorbed 5%

#3

100 scotch Pitch, 125 Asphalt Oil 12½ cts.
mixed easily, not sticky
Will not brick.

#4

Concentrated Wood tar 90, Asphalt Oil 10
mixed hard, is sticky, bricked well.
12½ cts unthread.
broke at a 4 foot fall on asphalt floor.
Immersed in water 16 hours, absorbed
9%

#5

Concentrated Wood tar, 80 Beech wood Creosote
20, - 12½ cts unth
Mixed hard, not very sticky
broke on a 3 foot fall on asphalt floor.
Immersed in water 16 hours, absorbed
6.9%

May 15th

Experiments to determine water absorption of Various Rosin & Lime mixtures.

#1

Rosin 100 Lime 50, 12½ cts.
Immersed in H_2O 16 hours,
gained 3.15% water

#2

Rosin 100 Lime 52½, 12½ cts
Immersed in H_2O 16 hours
gained, 3.87%

#3

Rosin 100 Lime 55, 12½ cts,
Immersed in H_2O 16 hours,
gained 5.49%

#4

Rosin 100 Lime 57½ - 12½ cts.
Immersed in H_2O 16 hours,
gained 1.25%

#5

Rosin 100 Lime 60 12½ cts
Immersed in H_2O 16 hours
gained 2.35%

#6

Rosin 100 Lime 62½ 12½ cts.
Immersed in H_2O 16 hours
gained 1.36%

Aug 9th 1895

Muck in Muck house,

Rosin 100
Petroleum 45

Rosin 700 lbs
Oil 320 lbs

Rosin is to be melted first, then Oil run in.
This proportion is used in hot weather, In winter it will be necessary to use more oil.

Standard muck consists of

Rosin 100
Petroleum 50
In winter it may be necessary to use Rosin 100
Oil 57½ this reduces th

number of "balls", caused by cold weather.

The following is a scale of lbs of standard muck at different prices,

10 cts,	22.5 lbs	muck per ton ore
11 "	24.75 "	" " " "
12 "	27.00 "	" " " "
13 "	27.25 "	" " " "
14 "	31.50 "	" " " "
15 "	33.75 "	" " " "
16 "	36.00 "	" " " "
17 "	38.25 "	" " " "
18 "	40.50 "	" " " "
19 "	42.75 "	" " " "
20 "	45.00 "	" " " "

Mixers are to receive 400 lbs concentrates per minute, and muck lift sprocket to run at 1 2/3 revs per minute to give 45 lbs hot muck per 2240 lbs ore, = 20 cts, = 8 lbs muck, 400 lbs ore

Bricks are to be baked at between 475° F, to 500° F for one hour, if baked at a lower temperature they may soften again on heating, if baked at a higher temperature they may oxidize, and become brittle on cooling

Bricks should not absorb more than 1.5 % water in 24 hours, if standard muck is used.

[ITEM FOUND IN BOOK]

Cable Address "Edison, New York"

From the Laboratory
of
Thomas A. Edison
Orange, N.J. May 12th 1904

Send this to Walcott to copy in log book
A.O.

Mr. Edison

The following experiments were made in bricks.

#1 – 100 Rosin	200 Wood Tar Oil,	12½ ozs,	absorbed	4.27%	water.
2 – 100 Scotch Pitch	250 "	" 12½ "	"	2.13%	"
3 – 100 Rosin	62 Asphalt Oil	12½ "	"	1.5%	"
4 – 100 Wood Tar Pitch	75 Asphalt Oil	12½ "	"	5.0%	
5 – 100 Scotch Pitch	125 Asphalt Oil,	12½ "	will not	brick.	
6 – 90 Concentrated Wood Tar	10 " "	12½ "	absorbed	9.0%	
7 – 80 " " "	20 Beech Wood Creosote,	12½ ozs	"	6.92%	

They were each mixed in mortar bricked in screw press, bar 3' from center, one man on bar. baked at 530°F for 1 hour.

#1 – Broke at 5 foot fall on asphalt floor. mixes easy, bricks well
2 – " " 10 " " " " " " hard " "
3 – " " 3 " " " " " easy, not sticky.
4 – " " 3 " " " " " hard " "
5 – no good
6 – Broke at 4 " " " " " hard, is pasty, bricks well
7 – " " 3 " " " " " " not very sticky

Joseph W. Harris.